An Analysis of Participation in Bird Watching in the United States

Yeong Nain Chi Jack Coburn Isaacs Jorge L. Icabalceta Herb A. Holloway David R. Lavergne[1]

Introduction

Wildlife-based recreation continues to be popular in the United States (U.S. Fish and Wildlife Service, 2002), long recognized for its rich array of biodiversity that supports a wide range of outdoor recreation activities. Wildlife-based recreation includes consumptive activities (such as fishing and hunting) and nonconsumptive or wildlife watching activities (such as observing, feeding, and photographing wildlife).

According to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 82 million U.S. residents 16 years old and older participated in wildlife-based recreation activities such as fishing, hunting, and wildlife watching. More than 66 million Americans participated in wildlife watching and spent $38.4 billion, while almost 46 million U.S. residents participated in observing, photographing, or feeding birds and spent $31.7 billion in 2001 (U.S. Fish and Wildlife Service, 2002).

According to the 1991, 1996, and 2001 National Surveys of Fishing, Hunting, and Wildlife-Associated Recreation, participation in residential bird watching decreased from 51.3 million in 1991 to 42.2 million in 1996, and in 2001 to 40.3 million. Participation in nonresidential bird watching decreased from 24.7 million in 1991 to 17.7 million in 1996, but slightly increased to 18.5 million from 1996 to 2001 (U.S. Fish and Wildlife Service, 1993, 1997, 2002).

Bird watching, that form of nature-based tourism drawing specific attention to the avian kingdom, remains popular for many diverse reasons: scientific research, personal pleasure, family outings, social interaction, and so forth. Bird watching activities rely on natural environmental attributes to attract participants to an area, who use its bird resources and their habitats as the focal point of the activities.

Although participants in bird watching number in the millions, little is known about the linkage between landscape characteristics and individual participation behavior. The purpose of this study is to analyze bird watching participation in order to contribute to a better understanding of current and future individual bird watching participation in the United States.

The remainder of this paper is divided into four sections. The following section presents a conceptual model that shows relationship between participation behavior and bird attributes, an empirical model and the data used in this study, respectively.

Methods

Conceptual Model

A conceptual model of bird watching participation was developed by integrating three components (Figure 1): bird watchers, bird resources, and bird habitats. This conceptual model demonstrates the context of the human-bird interaction and provides a framework that identifies utility maximization as the ultimate objective for the participants in bird watching in terms of their participation decisions. Bird watching can be viewed as an intermediate interface between the bird watcher and bird and its habitat. Without adequate bird resources and habitats, there would be far fewer or no participants in bird watching activities.

Based on identified participation patterns, bird watching activities can be identified as either residential (taking place less than one mile from home) or nonresidential (for trips of at least one mile from home with the specific intent of observing, feeding, or photographing birds). The choice of explanatory variables selected for empirical analysis is based on the conceptual model as described.

[1] Economists, Economist Manager, and Administrator, Socioeconomic Research and Development Section, Louisiana Department of Wildlife and Fisheries, P.O. Box 98000, Baton Rouge, LA 70898-9000. E-mail: Chi_YN@wlf.state.la.us (Corresponding Author).

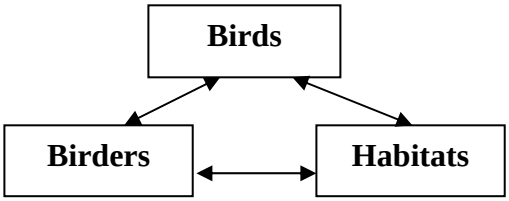

Figure 1 – The Conceptual Model of Bird Watching Participation

Because the nature and purpose of residential and nonresidential bird watching are distinct, the participation factors will likely differ. The residential bird watching participation equation estimated in this study is expressed as:

Participation = *f* (Income, Age, Gender, Marital Status, Education Level, Ethnicity, Bird List, Bird No, Parks, Maintain, Plants, μ_1);

The nonresidential bird watching participation equation estimated in this study is expressed as:

Participation = *f* (Income, Age, Gender, Marital Status, Education Level, Ethnicity, Prey, Waterfowl, Water Bird, Songbird, Others, Public Land, Private Land, Ocean, Lake, Marsh, Forest, Brush, Open Field, Man-Made, μ_2); where μ_1 and μ_2 are error terms for residential and nonresidential bird watching participation equations, respectively. Definition of explanatory variables used in the empirical models is provided in Table 1 and Table 3, respectively.

Empirical Model

The foundation of the modeling technique, known as the random utility model, is based on the assumption that an individual makes choices to maximize his or her utility when facing alternatives. While utility is not observable, the choices are. Since the selected choices are indicative of the utility, it is possible to model the individual perception based on these choices. Assume that the individual behaves so as to maximize his or her utility when choosing between two alternatives. Also, assume that the binary decision by the i^{th} individual can be conveniently represented by a random variable Y_i that takes the value one if one choice is made and the value zero if another option is chosen.

The Logit model is a commonly used technique to estimate binary choice models. This technique is very convenient to model the choice behavior of individuals when two alternatives are available and one must be chosen. The Logit model is selected in this analysis because its asymptotic characteristic constrains the predicted probabilities to a range of zero to one. It is also favored for its mathematical simplicity and is often used in a setting where the dependent variable is binary (Judge, et. al., 1988; Greene, 1997).

Consider an individual participant *i* who is faced with the choice problem of whether or not participate in a particular event. The Logit model can be specified statistically as:

$$y_i = 1 \quad \text{if } y_i^* = x_i\beta + \varepsilon_i > 0$$
$$y_i = 0 \quad \text{if } y_i^* = x_i\beta + \varepsilon_i \leq 0 \qquad (1)$$

where y_i is a vector of binary dependent variables which take on the values of 1 for a "yes" answer and 0 for a "no" answer, y_i^* is a vector of unobservable latent variables measuring the degree of participants willingness to participate in bird watching in this case, x_i is a vector of observed explanatory variables that influence participation, β is a vector of unknown parameters, and ε_i is a vector of error components.

The probability of participation to be estimated can be represented as:

$$\text{Prob}(y_i = 0 \mid x_i) = \text{Prob}(\varepsilon_i \leq -x_i\beta) = F(-x_i\beta) \qquad (2)$$

And also,

$$\text{Prob}(y_i = 1 \mid x_i) = \text{Prob}(\varepsilon_i > -x_i\beta) = 1 - F(-x_i\beta) \qquad (3)$$

where F(.) is the cumulative distribution function for ε_i.

The Logistic distribution for the error term, ε_i, can be expressed as:

$$F(-x_i\beta) = \exp(-x_i\beta)/[1 + \exp(-x_i\beta)] \qquad (4)$$

and also,

$$1 - F(-x_i\beta) = 1/[1 + \exp(-x_i\beta)] \qquad (5)$$

Therefore, the log likelihood function for a given sample of y_i's and x_i's can be written as:

$$\text{Log-L} = \Sigma_0 \ln F(-x_i\beta) + \Sigma_1 \ln[1 - F(-x_i\beta)] = \Sigma_0 \ln\{\exp(-x_i\beta)/[1 + \exp(-x_i\beta)]\} + \Sigma_1 \ln\{1/[1 + \exp(-x_i\beta)]\} = \Sigma_0 \ln(-x_i\beta) - \Sigma_1 \ln[1 + \exp(-x_i\beta)] \quad (6)$$

Due to the discrete nature of the dependent variable, y_i, the classical least squares method is not an appropriate technique to estimate this type of model (Amemiya, 1981). The maximum likelihood coefficients are asymptotically consistent, efficient, and normally distributed, and the t-test is a valid test of significance (Greene, 1997).

Data

Data used in this study were extracted from the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, which is conducted by the U.S. Census Bureau for the U.S. Fish and Wildlife Service, of 15,300 wildlife watchers (U.S. Fish and Wildlife Service, 2002). Data include participation, expenditures, and personal characteristics selected from detailed interviews in 2001.

The primary questions used in this study were "Did you observe, photograph, or feed wild birds during 2001 in the United States around your home?" for residential bird watching participation, and "Did you Did you observe, photograph, or feed wild birds during 2001 in the United States at least a mile from home?" for nonresidential bird watching participation, respectively. In addition, information on individual characteristics including total household income, age, gender, marital status, education, ethnicity, and information on birding characteristics and landscape characteristics were used in this study.

Results

Based on descriptive statistics, respondents were on average 48 years old, had an average of 14 years of school and an average household income of $39,450. Ninety-three percent of respondents identified themselves as white, and most respondents were female (53%) and married (70%). Residential and nonresidential bird watching participation equations were estimated independently using the LIMDEP (Version 7.0) LOGIT procedure (Greene, 1995.

Residential Bird Watching Participation Model

Empirical results of the residential bird watching participation model are presented in Table 2. In the case of the dependent variable, approximately 72% of respondents reported that they observed, photographed, or fed wild birds during 2001 in the United States around their home. As hypothesized, the independent variables INCOME, AGE, FEMALE, MARRIED, HIGHSCHOOL, WHITE, BIRDLIST, BIRDNO, PARKS, MAINTAIN, and PLANTS were all positively and significantly related to residential bird watching participation.

Table 1 - Explanatory Variables for Residential Bird Watching Participation

Variables	Definition
PARTICIPATION	1 if respondent participated in residential bird watching; 0 otherwise.
INCOME	Respondent's total household income during 2001.
AGE	Respondent's age (in years) (16 years old and older).
FEMALE	Respondent's gender; 1 if female; 0 otherwise.
MARRIED	Respondent's marital status; 1 if married; 0 otherwise.
HIGHSCHOOL	Respondent's education level; 1 if attended high school; 0 otherwise
WHITE	Respondent's ethnicity; 1 if white; 0 otherwise.
BIRDLIST	1 if respondent kept a birding life list; 0 otherwise.
BIRDNO	Respondent's ability to identify different kinds of birds by sight or sound.
PARKS	1 if respondent visited any public parks or public-owned natural areas near home; 0 otherwise
MAINTAIN	1 if respondent maintained any natural areas for wildlife around home; 0 otherwise.
PLANTS	1 if respondent maintained any plantings as food or cover plants for wildlife around home; 0 otherwise.

Table 2 - Empirical Results for Residential Bird Watching Participation

Variable	Parameter Estimate	Standard Error	Marginal Probability
CONSTANT	-0.37763*	0.19989	------
INCOME	0.165E-05*	0.706E-06	0.220E-06
AGE	0.05572*	0.00812	0.00742
FEMALE	0.29499*	0.04603	0.03927
MARRIED	0.15040*	0.05407	0.02002
HIGHSCHOOL	0.24264*	0.08669	0.03230
WHITE	0.66311*	0.08076	0.08827
BIRDLIST	0.85464*	0.34283	0.11377
BIRDNO	0.00288*	0.00006	0.00038
PARKS	0.48196*	0.08938	0.06416
MAINTAIN	0.55666*	0.11947	0.07410
PLANTS	1.78160*	0.14116	0.23716
Log-Likelihood		-5947.518	
Chi-Squared		6175.174	

*The critical t-statistic at the 95 percent confidence level is 1.645

The positive and significant coefficient of INCOME showed that the demand for residential bird watching activities increased with income. The coefficient of AGE indicated that a respondent's age had a positive and significant impact on the likelihood to participate in bird watching around home. The FEMALE variable was estimated to be positive and significant, indicating that women were 4% more likely to participate in residential bird watching activities than men.

The positive and significant coefficient of MARRIED indicated that married individuals were 2% more likely to participate in residential bird watching than unmarried individuals. The HIGHSCHOOL variable was estimated to be positive and significant, with the interpretation that respondents with high school education were 3% more likely to

participate in bird watching activities around home than those with lower or higher levels of education. The positive and significant coefficient of WHITE when compared to other ethnic categories, with the interpretation that whites were about 9% more likely to participate in residential bird watching activities than individuals of other ethnic backgrounds. The BIRDNO variable was positive and statistically significant as expected, indicating that the demand for residential bird watching activities increased with the ability to identify different kinds of birds by sight or sound without the use of an identification book. The BIRDLIST variable was estimated to be positive and significant, with the interpretation that respondents with keeping a bird life list were 11% more likely to participate in bird watching activities around home.

The positive and significant coefficient of PARKS showed a link between at-home bird watching and outdoor recreation activity away from home. Respondents who visited parks and other public natural areas were 6% more likely to participate in bird watching activities at home than those who did not visit such facilities.

Residential landscaping practices were also related to bird watching participation. The variable MAINTAIN was estimated to be positive and significant as expected, indicating that respondents who like to maintain any natural areas for wildlife around home were 7% more likely to participate in residential bird watching activities. The coefficient for PLANTS indicated that respondents maintained any plantings as food or cover plants for the primary purpose of benefiting wildlife around home had a positive and significant effect, with 24% more likely to participate in bird watching around home.

In summary, empirical results show participation in residential bird watching increases with income and age. Women are more likely than men, married people are more likely than non-married people, and whites are more likely than non-whites to participate in bird watching activities at home. Individuals who can identify a number of different kinds of birds or keep a birding life list are more likely to participate in at-home bird watching than those who do not. Visiting public parks or public-owned natural areas and maintaining natural areas or plantings for wildlife around home also affected participation significantly.

Nonresidential Bird watching Participation Model

Empirical results of the residential bird watching participation model are presented in Table 4. Approximately 24% of respondents reported that they observed, photographed, or fed wild birds during 2001 in the United States at least a mile from home. The independent variables included categories of encountered birds (PREY, WATERFOWL, WATER BIRD, SONGBIRD, and OTHERS), land-ownership categories (PUBLIC LAND and PRIVATE LAND), and landscape categories (OCEAN, FOREST, MARSH, and MAN MADE).

The variables PREY, WATERFOWL, WATER BIRD, SONGBIRD, and OTHERS were all estimated with the hypothesized positive sign and were all statistically significant, but to a varying degree of magnitude. Participation in nonresidential bird watching was more noticeably pronounced among respondents reporting encounters (observing, photographing, or feeding) with waterfowl, songbirds, and birds of prey. Those who had encountered waterfowl in the previous year were 32% more likely to bird watch away from home than those who had not. Nonresidential bird watching activities rose 32% if the respondent encountered waterfowl, 26% if the respondent had observed, photographed, or fed songbirds and 20% if he or she had encountered birds of prey in the last 12 months. Observing, photographing, or feeding water birds (such as shorebirds, herons, pelicans, or cranes) prompted only a modest (7%) increase in nonresidential bird watching participation.

The variable PUBLIC LAND was estimated to be positive and statistically significant as expected, indicating that respondents were 31% more likely to participate in nonresidential bird watching at any areas on land owned by the Local, State, or Federal Government. Similarly, the positive and significant coefficient of PRIVATE LAND indicated that respondents were 13% more likely to participate in bird watching at any areas on privately owned land at least a mile from home.

Table 3 - Explanatory Variables for Nonresidential Bird Watching Participation

Variables	Definition
PARTICIPATION	1 if respondent participated in nonresidential bird watching ; 0 otherwise.
MIDINCOME	Respondent's total household income during 2001; 1 if between $25,000 and $49,999; 0 otherwise.
AGE	Respondent's age (in years) (16 years old and older).
FEMALE	Respondent's gender; 1 if female; 0 otherwise.
MARRIED	Respondent's marital status; 1 if married; 0 otherwise.
COLLEGE	Respondent's education level; 1 if attended college; 0 otherwise
MINORITY	Respondent's ethnicity; 1 if minority; 0 otherwise.
PREY	1 if respondent observed/photographed/fed birds of prey; 0 otherwise.
WATERFOWL	1 if respondent observed/photographed/fed waterfowl; 0 otherwise.
WATER BIRD	1 if respondent observed/photographed/fed other water birds; 0 otherwise.
SONGBIRD	1 if respondent observed/photographed/fed songbirds; 0 otherwise.
OTHERS	1 if respondent observed/photographed/fed other birds; 0 otherwise.
PUBLIC LAND	1 if respondent visited any areas on land owned by the Local, State, or Federal Government; 0 otherwise.
PRIVATE LAND	1 if respondent visited any areas on privately owned land; 0 otherwise.
OCEAN	1 if respondent visited an ocean side to observe, photograph, or feed wildlife; 0 otherwise.
LAKE	1 if respondent visited a lake or stream side to observe, photograph, or feed wildlife; 0 otherwise.
MARSH	1 if respondent visited a marsh/wetland/swamp to observe, photograph, or feed wildlife; 0 otherwise.
FOREST	1 if respondent visited a woodland to observe, photograph, or feed wildlife; 0 otherwise.
BRUSH	1 if respondent visited a brush-covered area to observe, photograph, or feed wildlife; 0 otherwise.
OPEN FIELD	1 if respondent visited an open field to observe, photograph, or feed wildlife; 0 otherwise.
MAN MADE	1 if respondent visited a man-made area to observe, photograph, or feed wildlife; 0 otherwise.

Table 4 - Empirical Results for Nonresidential Bird Watching Participation

Variable	Parameter Estimate	Standard Error	Marginal Probability
CONSTANT	-2.9695*	0.13474	------
MIDINCOME	0.0125	0.08199	0.00200
AGE	-0.0007	0.00216	-0.00012
FEMALE	0.0413	0.07026	0.00660
MARRIED	0.0089	0.07775	0.00143
COLLEGE	0.0102	0.07143	0.00164
MINORITY	0.0747	0.11347	0.01192
PREY	1.2886*	0.12917	0.20575
WATERFOWL	1.9909*	0.12723	0.31789
WATER BIRD	0.4459*	0.15809	0.07119
SONGBIRD	1.6513*	0.13034	0.26366
OTHERS	0.6380*	0.15651	0.10187
PUBLIC LAND	1.9551*	0.11388	0.31217
PRIVATE LAND	0.8209*	0.13414	0.13107
OCEAN	0.6408*	0.16885	0.10232
LAKE	0.1287	0.12311	0.02054
MARSH	-0.2344*	0.14093	-0.03742
FOREST	0.3482*	0.13600	0.05560
BRUSH	-0.1708	0.14078	-0.02728
OPEN FIELD	0.0743	0.13250	0.01186
MAN MADE	-0.2694*	0.15097	-0.04302
Log-Likelihood		-1287.856	
Chi-Squared		14173.51	

*The critical t-statistic at the 95 percent confidence level is 1.645

The variables OCEAN and FOREST were estimated to be positive and significant, with the interpretation that respondents were 10% and 5% more likely to observe, photograph, or feed bird at ocean sides and woodlands, respectively. Inversely, the negative and significant coefficients of MARSH and MAN MADE variables showed that respondents were 2% and 4% less likely to observe, photograph, or feed bird at lake or stream sides and man-made areas, respectively.

Discussion and Implications

This research presented a conceptual model that considers the relationship between humans and birds, used in the empirical analysis of determinants of bird watching participation behavior. Biodiversity is assumed to be the foundation upon which a sound nature-based tourism can be built.

The conservation of biodiversity has become an important objective for a number of public land managers and private landowners in the United States, working through a cooperative, coordinated framework of action. The efficacy of this effort in decelerating the loss of biodiversity in the United States faces at least one significant impediment: a lack of knowledge about biodiversity and its susceptibility to human activities.

Effective planning and management of natural resources may improve the quality of outdoor recreation experiences for participants while enhancing its contribution to a community's economy. From a nature-based tourism promotion perspective, a successful marketing campaign for bird watching must not only target to those who already have a strong interest in participating in bird watching activities, but also reach out to potential participants unfamiliar with this nature-based concept.

The results of this study are multi-dimensional. First, gender does not appear to be a distinguishing factor in residential and nonresidential bird watching activities. Thus, natural resource managers have an opportunity to include a previously excluded user group in their management plans, expanding a shrinking constituency. Second, though public parks or public-owned natural areas are important to the provision of opportunities for environmental education, especially for individuals in the urban environment, people should not overlook the role of private land in providing opportunities for bird watching activities. Third, the availability of a diversity of species and ecosystem plays an important role in bird watching. Resource managers should educate the public about the availability or location of diverse habitats to generate continued interest and increased participation in nonresidential bird watching.

The finding of this study points out that a healthy natural environment supports a diverse array of processes that provide both goods and services to human beings. Also, the empirical results of this study provide insight into the determinants of participation in bird watching, which can be used in analyzing the social and economic impacts of bird resources and habitat planning and management.

Literature Cited

Amemiya, T. (1981). Qualitative Response Models: A Survey. *Journal of Economic Literature* 19(4): 483-536.

Duffus, D.A., and P. Dearden. (1990). Non-Consumptive Wildlife-Oriented Recreation: A Conceptual Framework. *Biological Conservation* 53: 213-231.

Green, W. H. (1995). *LIMDEP User's Manual, Version 7.0.* New York, Bellport: Econometric Software, Inc.

Greene, W.H. (1997). *Econometric Analysis*. New York, N.Y.: Macmillan Publishing Company.

Judge, G. G., R. C. Hill, W. E. Griffiths, H. Lutkepohl, and T. C. Lee. (1988). *Introduction to the Theory and Practice of Econometrics*. New York, N.Y.: John Wiley & Sons, Inc.

Rockel, M.L., and M.J. Kealy. (1990). The Value of Nonconsumptive Wildlife Recreation in the United States. *Land Economics* 22:31-38.

Stynes, D.J., and G.L. Peterson. (1984). A Review of Logit Models with Implications for Modeling Recreation Choices. *Journal of Leisure Research* 16: 295-310.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. (1993). *1991 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. (1997). *1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. (2002). *2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*.

U.S. Department of the Interior, Fish and Wildlife Service. (2003). *Birding in the United States: A Demographic and Economic Analysis*. Addendum to the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. Report 2001-1.